Psychological Predictors of Fitness and Performance in Active Duty U.S. Navy Personnel*

David G. McDonald

Departments of Psychology and Psychiatry
University of Missouri - Columbia
Columbia, Missouri

Marcie B. Beckett
and James A. Hodgdon

Naval Health Research Center
San Diego, California

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Correspondence concerning this article should be addressed to David G. McDonald, Department of Psychology, University of Missouri--Columbia, 210 McAlester Hall, Columbia, Missouri, 65211.

Summary

The primary purpose of the present study was to assess the role of psychological variables (e.g., mood scales, physical estimation and attraction, physical self-concept, and personality scales) in predicting physical performance and fitness measures in a sample of military volunteers. Subjects were 102 active duty U.S. Navy personnel, 64 males and 38 females. Subjects performed a number of physical performance and fitness tasks (including 1.5-mile run, carrying task, and incremental treadmill task), and completed a battery of standardized questionnaires. Results were analyzed by multiple regression technique. The primary findings were: (a) Questionnaire measures, most notably the Attraction score from the Physical Estimation and Attraction scale, can be used to predict performance and fitness measures in an active duty Navy sample; (b) While fitness measures are clearly superior to questionnaire measures in predicting physical performance, questionnaire measures, again most notably the Attraction score, can be used to enhance the prediction equation over fitness measures alone; (c) There were only minimal differences between males and females in significance of questionnaire measures to predict performance or fitness.

Introduction

Human performance in a demanding physical task is a product of many contributing factors, including fitness, prior experience, and a host of mediating variables, such as mood, attitude, motivation, self-concept, personality characteristics, and the like. While the precise nature of these relationships is highly complex, it is still possible to assess the role of the various components independently. For example, recent studies from this laboratory have clearly demonstrated that fitness variables can be used reliably to predict performance on a variety of tasks designed to emulate shipboard requirements in a representative sample of active duty U.S. Navy personnel (Beckett & Hodgdon, 1987b).

It also follows then that one sensible extension of this work is to investigate the relative contribution of these other factors in order to enhance or maximize whatever descriptive or predictive capacity may be possible. The purpose of the present study, therefore, was to focus on psychological measures (e.g., mood scales, physical estimation and attraction, self-concept, and personality scales) as both descriptive and predictive measures of physical performance, by means of both simple correlational and multiple regression techniques. It is well known that no psychological measure could possibly replace fitness measures in any prediction equation; however, the relative contribution of such psychological data can certainly be evaluated independently.

We recognize that there is an extensive literature on the psychological effects of fitness training. However, space limitations prevent our including this work in the present review. Furthermore, we were primarily concerned with studies in which the psychological measures were used to predict performance, rather than studies in which psychological measures were used to assess the effects of training (i.e., after the fact), whether including performance or not. Defined in this more limited manner, the previous literature is much less extensive. In fact, if one also requires that only studies of active duty military personnel be included, then the previous work shrinks to virtually nothing.

In spite of this paucity of data, however, it should be noted that there are some encouraging reports in the literature. Heaps (1978) has reported a study in which male students first received either positive or negative information about their fitness levels on a prearranged basis, and they were then asked to rate their physical fitness. Curiously, the results indicated that a person's perception or attitude about his physical condition, not his actual fitness, was more highly correlated with measures of self-acceptance and anxiety. In addition, Tucker (1983) has shown that muscular strength can be a statistically significant predictor of personality measures, notably body cathexis, neuroticism, extraversion, and self-concept in college males. Further, in a replication study with college females, Balogun (1986) also found that muscular strength predicted self-esteem and degree of satisfaction with body parts in females, although the correlation coefficients were marginally significant, and about 70% of the variance still remained unexplained. While these studies present a logical reversal of the independent and dependent variable relationships of the present report, they nonetheless signify that there are measurable relationships among the variables to be studied. And, while college students are not identical to active duty military personnel, it is also true that they are quite similar in age, presumed health, and related characteristics, making careful comparisons justifiable.

On the other hand, as all of these authors point out, there are serious inconsistencies in the existing literature, making extensive comparisons somewhat hazardous. For example, even on a question as simple as the correlation between fitness measures and <u>any</u> personality characteristics, the literature is fairly evenly split. Sharp and Reilley (1975) and Young and Ismail (1976) both report significant correlations between fitness measures and various scales on personality inventories. Both investigators studied male subjects, but Sharp and Reilley used the Minnesota Multiphasic Personality Inventory (MMPI; Hathaway & McKinley, 1951), whereas Young and Ismail used the Cattell Sixteen Personality Factor Questionnaire (16PF; Cattell, Eber, and Tatsuoka, 1970).

This suggests that personality characteristics might be measured in a variety of approaches, with equal likelihood of ultimate success. However, this conclusion is not supported by other reports. Weber (1953) and Hammer and Wilmore (1973), also studying male subjects, found no relationships between fitness measures and the MMPI and 16PF, respectively. Thus, if one prefers box score counts, the results would appear to be two-two at this point, even though such a statement is obviously an oversimplification.

Admittedly, these studies differ in many details. For example, no two of them used the same measures of fitness, some assessing strength more than endurance, and some concentrating on endurance. In addition, there is no reason to expect that all personality inventories should be equally useful in such studies. For example, the 16PF has been the subject of some rather detailed criticism (Walsh, 1978; Zuckerman, 1985), although others strongly favor use of this instrument (Bolton, 1978). No one, however, makes the case that the 16PF and MMPI are interchangeable inventories.

As a further note, we also wish to point out that, with the sole exception of the report by Balogun, all of the previous investigators used male subjects. Koval, Patton, and Vogel (1978), in a tangentially related study, did find that basic training was associated with significant differences in measures of mood, anxiety, and self-concept in male recruits, but not in females. However, since they compared scores of two independent samples before and after basic training, there remains some possibility that the observed differences were due to sampling variability. There are thus serious limitations in the extent to which results of previous work can be generalized to actual duty conditions of modern shipboard personnel in the U.S. Navy, or any other branch of the current armed services, because of the more extensive duty assignments of females in the military in recent years.

The following, then, is a report of a study in which many of these considerations were addressed in several ways. First, the sample that we employed consisted of both males and females, recruited from a large pool of active duty Navy personnel. We also used a broader group of standardized questionnaires than found in any of the studies cited above, but which we found to be useful in a previous study with a much different military sample (McDonald, Norton, and Hodgdon, 1988). Further details about this group of questionnaires are given below.

The study was designed to address the following specific questions:

(a) Can questionnaire measures (by themselves) be used to predict either fitness or physical performance measures?

(b) Can questionnaire measures be used to increase the established predictive power of fitness measures to predict physical performance?

(c) What are the similarities and differences between males and females of a single sample in the use of questionnaire measures to predict fitness or physical performance?

We were also interested in a number of related questions, e.g., "Which questionnaire measures?" and, "To predict what aspects of fitness or physical performance?"

It was our considered opinion that the present study, therefore, provided us a number of opportunities for unique observation in a highly complex problem area. This report is also limited to the questionnaire data. Another report (Beckett & Hodgdon, 1987b) from this laboratory has been devoted to the relationship between lifting and carrying capacities and physical fitness measures.

Method

Subjects

The subjects were 102 active duty U.S. Navy personnel who volunteered to participate in response to a locally circulated request for volunteers. All data collection was conducted at the Department of Applied Physiology, Naval Health Research Center, San Diego, California.

Means and standard deviations of the male and female groups for age, height, weight, fat-free mass (FFM), and fat mass (FM) are summarized in Table 1. Results of t tests between male and female means showed that the males were taller, heavier, and had more FFM than the females, with $p<.001$

in each case. However, there were no differences between the two groups in mean or range for age. Thirty-five was the maximum age permitted. In addition, while there were no differences between males and females in FM shown in Table 1, there were male/female differences in percent body fat, as will be seen below.

Table 1
N's, Means and Standard Deviations of the Male and Female Groups for Age, Height, Weight, Fat-Free Mass (FFM), and Fat Mass (FM)

	Males		Females	
N	64		38	
Variable	Mean	s.d.	Mean	s.d.
Age	27.8	3.93	27.6	4.14
Height (cm)	177.8	7.02	165.4	6.02
Weight (kg)	81.5	12.17	61.4	7.64
FFM (kg)	66.7	7.34	46.2	4.39
FM (kg)	14.8	8.32	15.2	5.83

Testing procedures

The full set of testing procedures, which included certain performance and fitness measures not included in the present report, has been reported previously by Beckett and Hodgdon (1987b) in greater detail than feasible here. The following is a summary of the tasks and events as scheduled. All subjects visited the laboratory on five separate occasions, spaced over a two week interval. The primary purpose and the general nature of each visit was as follows:

Day One. Subjects were given a briefing on the general nature of the study, possible risks and benefits, and signed a voluntary consent form. All subjects were screened for medical conditions that could limit performance or increase risk of injury during the experiment. They were then given a lift strength screening test. This test consisted of lifting a small metal box held at knuckle height and attached to a dynamometer near the subject's feet; subjects were required to demonstrate a dynamometer strength of at least 168 lb., based on expected lifting requirements in the experiment proper. Four female volunteers failed to pass this screen and are not included in this report. No males failed the screen. All subjects then completed the battery of standardized questionnaires.

Day Two. Subjects participated in seven field events to provide measures of physical capacity. These consisted entirely of field events that are not part of the present report, including sit-reach, sit-ups, push-ups, pull-ups, several jump events, and a 100-m sprint.

Day Three. Subjects performed a 1.5-mile run, plus a lifting task that is not part of this report.

Day Four. Measures of body composition were taken, and the box carry task was conducted.

Day Five. Subjects performed the maximum effort incremental treadmill task to measure maximum oxygen uptake.

Questionnaire measures

The questionnaires administered to all subjects consisted of the following:

(1) The Physical Estimation and Attraction scale (PEAS; Sonstroem, 1974). This is a 100-item questionnaire that has been shown by Sonstroem (1976) to correlate with self-perceptions of physical and athletic ability and was also found to be useful in a related previous study in this laboratory (McDonald, Norton, and Hodgdon, 1988). It yields scores on two scales, Estimation and Attraction, intended to assess physical self-concept and interest in physical activities, respectively.

(2) The Profile of Mood States (POMS; McNair, Lorr, and Droppleman, 1971). This is a 65-item adjective checklist. It is reportedly one of the most widely used mood scales (Eichman, 1978), and it was found by McDonald and Hodgdon (1988) to be the most useful measure of mood changes following aerobic fitness training. There are six non-overlapping scales: Tension,

Depression, Anger, Vigor, Fatigue, and Confusion.

(3) The Tennessee Self Concept Scale (TSCS; Fitts, 1965). This is a 100-item self-concept questionnaire. It was found by McDonald and Hodgdon (1988) to be one of the most widely used self-concept questionnaires in aerobic fitness studies. It also provides two scores that _a priori_ seem related to the stated purpose of the present study: Physical self-concept (PSC) and total self-concept (TSC). The TSCS also includes a number of additional self-concept measures, however, there is some item overlap, and many of these additional scores are, therefore, intercorrelated (Fitts, 1965, pp. 15-16), with scale correlations ranging from .75 to .96. We therefore used only two scores, PSC and TSC, in spite of the fact that they are reported by Fitts to correlate .75.

(4) Hogan Personality Inventory (HPI; Hogan, 1985). This is a 310-item questionnaire that yields 10 standard scores: Intellectance (INT), Adjustment (ADJ), Prudence (PRU), Ambition (AMB), Sociability (SOC), Likeability (LIK), Validity (VAL), Service Orientation (SOI), Resiliency (RES), and Reliability (RLB). The first six of these scales are free of item overlap; however, there is minimal overlap among some of these six and Service Orientation, Resiliency, and Reliability scales, respectively. The HPI has been found to predict several aspects of job performance in a variety of occupational settings, some with military relevance (Biersner & Hogan, 1984; Hogan, Hogan, and Busch, 1984).

<u>Measures of physical performance</u>

While a number of performance measures were taken from the present sample, only two are used in the present report as primary dependent variables - 1.5-mile run time, and box carry:

(1) 1.5-Mile Run. All subjects ran 1.5 miles on an oval quarter-mile track in groups of 2-10. Subject's score (Runtime) was the total elapsed time in minutes to finish. This measure was chosen because of previous experience in this laboratory (Beckett & Hodgdon, 1987a), plus the fact that it is one of the items in the Navy's Physical Readiness Test, and it is a well established measure of aerobic fitness.

(2) Box Carry. This measure was designed to simulate a common shipboard physical task, viz, repeated carrying of objects. The task has been described in more detail by Beckett & Hodgdon (1987b). Subjects were required to carry a 75-lb. metal box as far as possible over a 51.4-m course in two 5-minute periods, with one minute rest intervening. Subject's score was the total distance the box was carried in the two periods. This score was converted to Box Carry Power (BCPWR) in watts as the primary dependent variable by the formula, BCPWR = weight X distance / time.

Physical fitness measures

Physical fitness was evaluated by measures of body composition and aerobic capacity.

(1) Body Composition. Percent body fat was assessed by a formula using height, plus neck and abdomen circumferences (males) or neck, waist, and hip circumferences (females), as described by Hodgdon and Beckett (1984a, 1984b). From this information, it was straightforward to compute fat mass (FM = total weight X fraction of body fat) and fat-free mass (FFM = total weight - FM).

(2) Aerobic capacity. Aerobic capacity was assessed by means of a standard incremental treadmill task. Subjects walked 3 minutes at a treadmill speed of 3 mph and then ran at a treadmill speed of 5.0 or 5.5 mph for 3 minutes. Thereafter the treadmill speed was increased by 0.5 mph each minute until a comfortable running pace was achieved. The grade of the treadmill was then increased 1% each minute (while maintaining constant treadmill speed) until the subject could no longer continue. The rate of oxygen consumption (VO2) was determined simultaneously by open-circuit spirometry. Aerobic capacity was maximum oxygen uptake, measured by the greatest 1-minute VO2 value, expressed as VO2MAX, calculated by O2 ml/min X kg body weight. VO2MAX is considered to be the most valid measure of an individual's cardiovascular capacity, plus endurance and maximum performance capability. As a correction for percent of body fat, we also included VO2FFM, calculated from VO2MAX divided by fraction of FFM for each subject.

Results

Descriptive statistics

All statistical analyses, including descriptive statistics, matrices of intercorrelations, and multiple regression analyses, were performed on a VAX 11/780 computer, using Pearson Product-Moment Correlation, Stepwise Multiple Regression Analysis, and Condescriptive Procedures of SPSSX (Statistical Package for the Social Sciences). Means and standard deviations for all performance, fitness, and questionnaire measures for male and female groups are summarized in Table 2.

Table 2
Means and Standard Deviations of the Male and Female Groups for Performance Measures, Fitness Measures, and Questionnaire Scores

	Males		Females	
	Mean	s.d.	Mean	s.d.
RUNTIME	11.4	2.22	13.3	2.36
BCPWR	308.2	39.73	272.8	36.79
VO2MAX	50.6	6.91	44.7	7.39
% BODY FAT	17.4	7.76	24.3	7.32
VO2FFM	61.2	5.47	58.8	6.67
ESTIMATION	22.6	6.46	20.1	6.96
ATTRACTION	38.0	6.87	35.3	8.50
TENSION	8.5	4.63	8.4	5.47
DEPRESSION	5.2	6.72	7.1	8.92
ANGER	6.0	7.48	6.7	6.92
VIGOR	19.2	4.97	18.4	5.23
FATIGUE	5.2	4.27	4.7	5.44
CONFUSION	5.2	3.69	6.1	4.81
PHYSICAL SELF-CONCEPT	67.5	6.22	66.3	8.96
TOTAL SELF-CONCEPT	347.6	28.20	344.9	30.32
INTELLECTANCE	19.8	5.49	18.3	5.43
ADJUSTMENT	31.7	7.80	29.5	8.99
PRUDENCE	25.3	6.14	27.3	5.93
AMBITION	20.0	3.92	17.1	4.82
SOCIABILITY	11.7	4.33	10.7	4.20
LIKEABILITY	21.1	4.40	21.5	4.15
VALIDITY	15.1	1.37	15.1	0.95
SERVICE ORIENTATION	64.8	7.07	64.6	8.03
RESILIENCY	32.3	6.33	30.5	5.82
RELIABILITY	42.5	8.34	44.8	7.91

As can be seen in Table 2, the males performed better on the Runtime, BCPWR, and VO2MAX measures, and showed less % Body Fat, all of which were significant at $p<.001$ by t-test (two-tailed). The differences between males and females on VO2FFM, however, were more nearly borderline, (t = 1.97, two-tailed $p<.05$), indicating that the FFM correction greatly reduced, but did not totally eliminate, gender differences in VO2MAX. There were no differences between males and females in any of the questionnaire measures, with the sole exception of AMB scores (t = 3.31, two-tailed $p<.001$).

Intercorrelations between measures

Correlation matrices for all variables are presented in Tables 3-5 for the total group, and for males and females, respectively.

Inspection of Table 3 indicates that in general the performance and fitness measures were moderately to highly intercorrelated, with correlation coefficients ranging from .46 to .88 (disregarding sign). The questionnaire measure that correlated most highly and consistently with both performance and fitness measures was the Attraction score from the PEAS. This was followed in decreasing order by the Estimation score from the PEAS, the Ambition score from the HPI, and the Physical Self-Concept score from the TSCS. The remainder of the correlations between questionnaire measures and performance or fitness measures were not remarkable in the total group.

The results summarized in Table 4 for male subjects were similar in many respects. Most of the performance and fitness measures were again correlated (.34 to .87). The Attraction score was the questionnaire measure that correlated most highly with performance and fitness measures, followed by scores on Estimation, Ambition, Physical Self-Concept, and Prudence.

Results for the females in Table 5 were similar in magnitude of intercorrelations between performance and fitness measures (.42 to .84), and the fact that the Attraction score was the most highly correlated questionnaire measure, in spite of the relatively smaller sample of females versus males. The females also showed consistent correlations of Estimation, and Physical Self-Concept, and also Vigor, Anger, and Confusion, but not Ambition, with performance and fitness measures compared to the males.

Table 3
Matrix of Pearson Product-Moment Correlations Between
All Performance, Fitness, and Questionnaire Measures, Total Group

	RUNTIME	BCPWR	VO2MAX	%BFAT	VO2FFM	ESTIMAT	ATTRACT
BCPWR	-.67	--					
VO2MAX	-.88	.61	--				
% BODY FAT	.69	-.50	-.79	--			
VO2FFM	-.69	.46	.78	-.23	--		
ESTIMATION	-.36	.30	.30	-.32	.16	--	
ATTRACTION	-.55	.49	.46	-.40	.36	.58	--
TENSION	.13	-.09	-.07	.01	-.11	-.32	-.06
DEPRESSION	.12	-.09	-.05	.10	.03	-.24	-.10
ANGER	.10	-.00	-.07	.04	-.07	-.10	-.01
VIGOR	-.19	.16	.15	-.11	.14	.39	.22
FATIGUE	.05	-.05	-.02	.03	-.02	-.25	-.08
CONFUSION	.23	-.14	-.16	.14	-.12	-.37	-.22
PSC	-.27	.24	.21	-.23	.13	.59	.25
TSC	-.09	.12	.07	-.05	.08	.48	.09
INT	-.01	.09	.06	-.10	-.01	.18	.03
ADJ	-.17	.14	.05	.02	.11	.44	.19
PRU	.14	-.19	-.12	.26	.08	-.06	-.19
AMB	-.29	.28	.22	-.19	.15	.39	.36
SOC	-.06	-.03	.00	.02	.02	.21	.05
LIK	.05	.12	-.09	.06	-.06	.16	-.05
VAL	-.05	.16	.11	-.13	.05	.18	.04
SOI	-.10	.16	.02	-.05	-.00	.45	.14
RES	-.14	.16	.07	.02	.13	.35	.18
RLB	.05	-.01	.00	.11	.12	-.00	.15

	TENSION	DEPRESS	ANGER	VIGOR	FATIGUE	CONFUSE	PSC
DEPRESSION	.69	--					
ANGER	.55	.65	--				
VIGOR	-.52	-.37	-.22	--			
FATIGUE	.68	.66	.53	-.46	--		
CONFUSION	.71	.78	.59	-.45	.67	--	
PSC	-.57	-.48	-.31	.41	-.47	-.53	--
TSC	-.58	-.52	-.34	.33	-.35	-.55	.80
INT	.06	.10	.18	-.02	.09	.06	.18
ADJ	-.58	-.53	-.37	.40	-.40	-.58	.64
PRU	-.19	-.19	-.21	-.04	-.18	-.25	.04
AMB	.17	.10	.15	.06	.15	.06	.19
SOC	.05	.11	.08	.02	.07	.03	.14
LIK	-.32	-.20	-.23	.27	-.09	-.17	.39
VAL	-.22	-.07	-.11	-.06	-.10	-.10	.30
SOI	-.45	-.38	-.27	.39	-.25	-.43	.51
RES	-.24	-.28	-.12	.25	-.16	-.30	.33
RLB	-.43	-.35	-.35	.09	-.29	-.40	.20

(table continues)

	TSC	INT	ADJ	PRU	AMB	SOC	LIK	VAL
INT	.30	--						
ADJ	.70	.18	--					
PRU	.14	-.06	.18	--				
AMB	.13	.32	.14	-.47	--			
SOC	.11	.10	.10	-.31	.36	--		
LIK	.49	.10	.49	.09	.05	.18	--	
VAL	.33	.15	.22	.12	.16	.01	.37	--
SOI	.63	.09	.75	.14	.17	.10	.71	.42
RES	.46	.32	.64	.47	.05	-.11	.39	.26
RLB	.37	.03	.46	.69	-.35	-.48	.38	.31

	SOI	RES	RLB
RES	.60	--	
RLB	.45	.43	--

Note: Due to missing data, $N = 92$; $df = 90$
r of .20 = $p < .05$ (two-tailed)
r of .27 = $p < .01$ (two-tailed)

Table 4
Matrix of Pearson Product-Moment Correlations Between
All Performance, Fitness, and Questionnaire Measures, Male Subjects

	RUNTIME	BCPWR	VO2MAX	%BFAT	VO2FFM	ESTIMAT	ATTRACT
BCPWR	-.58	--					
VO2MAX	-.87	.51	--				
% BODY FAT	.63	-.34	-.76	--			
VO2FFM	-.68	.44	.74	.12	--		
ESTIMATION	-.33	.28	.34	-.43	.08	--	
ATTRACTION	-.44	.46	.34	-.36	.16	.61	--
TENSION	.20	-.07	-.10	.04	-.10	-.28	-.04
DEPRESSION	.08	-.02	-.07	.10	-.00	-.24	-.07
ANGER	.02	.14	-.01	.00	-.02	-.01	.05
VIGOR	-.14	.11	.07	-.05	.05	.43	.26
FATIGUE	.04	-.02	.03	.03	.08	-.17	-.07
CONFUSION	.14	-.01	-.10	.12	-.04	-.28	-.06
PSC	-.25	.29	.31	-.40	.08	.61	.23
TSC	-.07	.16	.14	-.18	.03	.48	.02
INT	-.01	.08	.01	.02	.04	.14	.04
ADJ	-.19	.18	.11	.00	.18	.33	.10
PRU	.22	-.18	-.26	.36	-.03	-.27	-.32
AMB	-.30	.30	.30	-.17	.28	.43	.44
SOC	-.14	-.02	.18	-.15	.13	.33	.06
LIK	.10	.04	-.12	.04	-.15	.19	-.07
VAL	-.05	.20	.16	-.17	.06	.15	.07
SOI	-.12	.18	.09	-.10	.03	.38	.10
RES	-.08	.14	.01	.10	.12	.13	.06
RLB	.11	.01	-.11	.21	.04	-.20	-.32

	TENSION	DEPRESS	ANGER	VIGOR	FATIGUE	CONFUSE	PSC
DEPRESSION	.70	--					
ANGER	.53	.62	--				
VIGOR	-.47	-.31	-.22	--			
FATIGUE	.67	.70	.56	-.42	--		
CONFUSION	.65	.79	.62	-.49	.68	--	
PSC	-.39	-.32	-.16	.23	-.24	-.33	--
TSC	-.42	-.39	-.20	.17	-.23	-.48	.77
INT	-.05	.04	.14	-.11	.02	-.02	.30
ADJ	-.53	-.43	-.28	.31	-.32	-.53	.48
PRU	-.09	-.33	-.26	-.11	-.16	-.32	-.11
AMB	.09	.23	.20	.01	.30	.15	.22
SOC	-.05	.21	.07	.17	.12	-.01	.17
LIK	-.24	-.02	-.11	.18	-.01	-.17	.20
VAL	-.12	-.00	-.09	-.21	.02	-.01	.30
SOI	-.42	-.27	-.17	.33	-.16	-.42	.42
RES	-.22	-.27	-.12	.11	-.13	-.30	.23
RLB	-.29	-.36	-.26	-.10	-.21	-.40	.05

(table continues)

	TSC	INT	ADJ	PRU	AMB	SOC	LIK	VAL
INT	.48	--						
ADJ	.58	.26	--					
PRU	.14	.04	.26	--				
AMB	.18	.25	.09	-.48	--			
SOC	.14	.17	.06	-.39	.36	--		
LIK	.44	.19	.50	.13	.16	.23	--	
VAL	.34	.18	.20	.08	.31	.14	.39	--
SOI	.60	.06	.70	.16	.17	.22	.76	.40
RES	.44	.38	.66	.57	-.10	-.12	.42	.25
RLB	.32	.05	.57	.73	-.24	-.41	.41	.24

	SOI	RES	RLB
RES	.56	--	
RLB	.46	.53	--

Note: Due to missing data, $N = 55$; $df = 53$
r of .26 = $p<.05$ (two-tailed)
r of .34 = $p<.01$ (two-tailed)

Table 5
Matrix of Pearson Product-Moment Correlations Between
All Performance, Fitness, and Questionnaire Measures, Female Subjects

	RUNTIME	BCPWR	VO2MAX	%BFAT	VO2FFM	ESTIMAT	ATTRACT
BCPWR	-.63	--					
VO2MAX	-.84	.58	--				
% BODY FAT	.62	-.49	-.75	--			
VO2FFM	-.69	.42	.82	-.24	--		
ESTIMATION	-.30	.22	.14	-.04	.19	--	
ATTRACTION	-.65	.48	.56	-.37	.51	.52	--
TENSION	.08	-.14	-.07	-.03	-.14	-.40	-.09
DEPRESSION	.08	-.08	.08	.02	.11	-.21	-.10
ANGER	.20	-.19	-.12	.06	-.12	-.22	-.06
VIGOR	-.21	.20	.22	-.14	.23	.32	.15
FATIGUE	.12	-.14	-.11	.08	-.14	-.36	-.10
CONFUSION	.28	-.22	-.15	.09	-.16	-.44	-.34
PSC	-.27	.17	.10	-.03	.15	.58	.26
TSC	-.09	.04	-.04	.20	.13	.48	.16
INT	.14	-.03	-.00	-.16	-.13	.18	-.03
ADJ	-.05	-.04	-.14	.17	-.02	.54	.24
PRU	-.12	-.06	.22	-.03	.30	.33	.03
AMB	-.06	-.01	-.11	.07	-.09	.27	.22
SOC	.17	-.21	-.37	.44	-.16	-.01	-.02
LIK	-.06	.34	-.00	.06	.06	.14	-.00
VAL	-.09	.19	.09	-.14	.04	.29	.02
SOI	-.08	.15	-.07	.03	-.04	.54	.19
RES	-.12	.07	.02	.05	.09	.63	.28
RLB	-.17	.14	.31	-.18	.30	.36	.12

	TENSION	DEPRESS	ANGER	VIGOR	FATIGUE	CONFUSE	PSC
DEPRESSION	.70	--					
ANGER	.58	.70	--				
VIGOR	-.58	-.42	-.22	--			
FATIGUE	.69	.64	.50	-.52	--		
CONFUSION	.79	.76	.58	-.40	.68	--	
PSC	-.74	-.60	-.48	.59	-.68	-.68	--
TSC	-.77	-.66	-.55	.54	-.50	-.62	.83
INT	.21	.22	.26	.08	.17	.18	.03
ADJ	-.65	-.62	-.48	.51	-.50	-.62	.79
PRU	-.33	-.09	-.15	.09	-.20	-.23	.24
AMB	.27	.06	.15	.08	-.02	.07	.13
SOC	.18	.02	.12	-.23	.00	.10	.10
LIK	-.44	-.44	-.46	.43	-.19	-.20	.43
VAL	-.45	-.20	-.18	.25	-.30	-.27	.35
SOI	-.49	-.49	-.42	.46	-.35	-.45	.61
RES	-.29	-.28	-.10	.44	-.20	-.29	.46
RLB	-.64	-.40	-.54	.39	-.39	-.45	.41

(table continues)

	TSC	INT	ADJ	PRU	AMB	SOC	LIK	VAL
INT	.03	--						
ADJ	.85	.04	--					
PRU	.16	-.17	.12	--				
AMB	.06	.36	.13	-.42	--			
SOC	.07	-.04	.12	-.16	.33	--		
LIK	.56	.02	.51	.01	-.07	.10	--	
VAL	.33	.10	.30	.23	-.06	-.29	.34	--
SOI	.67	.11	.81	.12	.17	-.09	.64	.49
RES	.49	.17	.60	.38	.14	-.16	.37	.30
RLB	.48	-.11	.38	.62	-.45	-.56	.32	.47

	SOI	RES	RLB
RES	.66	--	
RLB	.46	.35	--

Note: Due to missing data, N = 37; df = 35
r of .32 = $p < .05$ (two-tailed)

Multiple regression analyses

In order to address the previously listed primary questions of the present study, multiple regression techniques were used to predict combinations of performance or fitness measures in three regression models: (1) Using questionnaire measures alone to predict performance and fitness measures; (2) Using fitness and questionnaire measures in combination to predict performance in Runtime; (3) Using questionnaire measures alone to predict performance and fitness measures separately for males and females. During multiple regression, predictor variables were allowed to enter in a stepwise fashion, so long as the resulting change in variance explained was above the minimum requirement of 3%. The results of these multiple regression analyses are summarized in Tables 6-8.

Table 6 shows the results of multiple regression analyses in which the questionnaire measures alone were used to predict performance and fitness measures for the total group. The dependent variables were Runtime and BCPWR as measures of performance, and VO2MAX as a measure of fitness. As shown in Table 6, the Attraction score was the only predictor measure to enter in each equation, with multiple R's ranging from .358 to .553 for the total group. This result is compatible with the correlations shown in Table

3, specifically that the Attraction score was the questionnaire measure that was most highly and consistently correlated with all measures of performance and fitness. Other questionnaire measures that showed correlations with performance and/or fitness measures (e.g., PSC and AMB) were in turn correlated with Attraction, and hence did not in themselves add to the amount of variance explained.

Table 6
Multiple Regression Analyses, Using All Questionnaire Measures to Predict Performance and Fitness Measures, Total Group (N=92)

Dependent Variable	Predictor Entered	R	B*	S.E.+
1. Runtime	Attraction	.553	-.178	
	(constant)		18.729	2.06
2. BCPWR	Attraction	.488	2.692	
	(constant)		194.670	37.00
3. VO2MAX	Attraction	.468	.469	
	(constant)		30.925	6.80

*B is regression coefficient
+Standard error of estimate

Table 7 shows the results of multiple regression analysis in which VO2MAX, percent body fat (%BFAT), and questionnaire measures were used to predict the single performance measure, Runtime. This measure was chosen as the dependent variable because of its established history as a valid measure of performance. It can be seen that VO2MAX entered the prediction equation first, and the Attraction score entered as a predictor after the fitness measure. Thus, it would appear that the best predictor of Runtime was VO2MAX plus Attraction in the total group. This is compatible with conclusions drawn from Table 3, especially since VO2MAX and Attraction were the measures in their respective groupings most highly correlated with Runtime. It should also be noted that VO2MAX by itself predicted Runtime nearly as well. Clearly this would be expected because both VO2MAX and Runtime are running endurance measures, and their correlation has been noted previously in this laboratory and in numerous other studies.

Table 7
Multiple Regression Analyses, Using Fitness and all Questionnaire Measures to Predict Performance (Runtime), Total Group (N=92)

Dependent Variable	Predictors Entered	R	R-Square Change	B*	S.E.+	Fitness Predictors
Runtime	VO2MAX	.875	.765	-.254		VO2MAX &
	+Attraction	.890	.027	-.059		%BFAT
	(constant)			26.576	1.14	

*B is regression coefficient
+Standard error of estimate

Table 8 provides a summary of multiple regression analyses in which questionnaire measures alone were used to predict performance and fitness measures separately for males and females. The results in this case are similar to those presented in Table 6 in that the Attraction measure entered the equation in every case, with multiple R's ranging from .344 to .651. The Likeability and Sociability scores also entered once each (after Attraction) to predict BCFWR and VO2MAX, respectively, for females. Thus there appeared to be little difference between males and females in significance of the Attraction scores to predict performance or fitness measures, although there were some differences in secondary measures entering the prediction models.

Table 8
Multiple Regression Analyses, Using All Questionnaire Measures to Predict Performance and Fitness Measures, Males (N=55) and Females (N=37)

Dependent Variable	Predictors Entered	R	R-Square Change	B*	S.E.+
I. Males					
1. Runtime	Attraction	.437	.191	-.141	
	(constant)			16.734	2.01
2. BCPWR	Attraction	.460	.212	2.660	
	(constant)			207.230	35.60
3. VO2MAX	Attraction	.344	.118	.345	
	(constant)			37.502	6.55
II. Females					
1. Runtime	Attraction	.651	.424	-.181	
	(constant)			19.700	1.82
2. BCPWR	Attraction	.481	.231	2.084	
	+Likeability	.588	.115	3.006	
	(constant)			134.761	30.62
3. VO2MAX	Attraction	.555	.308	.477	
	+Sociability	.664	.134	.642	
	(constant)			34.669	5.68

*B is regression coefficient
+Standard error of estimate

Discussion

The primary findings of this study may be summarized as follows: (a) Questionnaire measures, most notably the Attraction score from the PEAS, can be used to predict performance and fitness measures in a group of U.S. Navy active duty personnel; (b) While fitness measures are clearly superior to questionnaire measures in predicting performance, questionnaire measures, again most notably the Attraction score, can be used to enhance the prediction equation over fitness measures alone; (c) There were only minimal differences between males and females in significance of questionnaire measures to predict performance or fitness measures, with the Attraction score being the best predictor of all questionnaire measures in both gender groups. While the males and females differed significantly on the usual measures of size, body composition, strength, and endurance, there were no gender differences in scores on questionnaire measures, with one apparent exception, the Ambition scores on the HPI, which were significantly different.

It therefore seems well established that questionnaire measures, in particular the Attraction scale from the PEAS, do show statistically significant relationships to measures of fitness and performance. This is not to suggest that psychological measures could be used to replace fitness measures in any equation to predict physical performance but rather that psychological variables do show the expected relationship in a measurable fashion. That the Attraction scale from the PEAS should be the best measure is logical and interpretable; however, it was not predicted to show the highest such relationship. Thus, it is sensible to find that a scale designed to measure interest in physical activities is the best questionnaire predictor of physical abilities, even though it was not necessarily expected on the basis of previous reports.

For example, Kowal, Patton, and Vogel (1978), and McDonald, Norton, and Hodgdon (1988) found the PEAS to be a useful instrument in related studies; however, in both cases it was the Estimation scale, rather than the Attraction scale, that was found to be most useful. There were, of course, a number of important differences between these previous reports and the present study. Koval et al. were primarily interested in measuring changes in Army recruits after basic training, while McDonald et al. measured changes in trainees (male only) for the U.S. Navy Special Forces. Thus the subjects in the Koval et al. study were younger and presumably less selected than those of the present report, while those in the McDonald et al. study were also younger but more select. This interpretation is borne out by comparison of the mean scores for each group. Mean scores on the Attraction scale in the Koval et al. and McDonald et al. studies were 31.6, and 43.2-45.3, respectively, compared to 36.9 in the present study. It thus seems highly likely that subjects in the three studies differed significantly in level of interest and therefore ultimate capability in a variety of physical activities, with subjects in the present report being somewhat more representative of the middle range of Attraction scale scores. In addition, the fact that the Attraction scale was reliably the best predictor in both gender groups in the present study is interpreted as a partial cross-validation because of the consistency of the results across independent groups. This is not to say that no further validation studies are necessary but rather that such efforts would be all the more warranted.

Further, there were a number of additional significant results in the present study, beyond the findings concerning the Attraction scale. Several other scales showed significant correlations with performance measures, most notably the Estimation scale from the PEAS, the Ambition scale from the HPI, and the Physical Self-Concept scale from the TSCS, all observed in the total group. Thus, while less significant than the Attraction scale, a combination of these scores would likely predict as well. In addition, there were promising indications that the Likeability and Sociability scales from the HPI could have predictive utility in females. These findings were less consistent and, therefore, more in need of cross-validation to establish their relationship to performance and fitness measures more accurately. It is virtually certain that some individual items in these various scales discriminated better than others, and thus a new scale, combining the best items from the PEAS, HPI, or TSCS, could be the best ultimate predictor. Such a new scale would of course require cross-validation.

It would appear that the results of the present study are both similar to and different from those reported by others. Previous studies differed among themselves in many obvious ways, which possibly accounts for many of the inconsistencies in results. Our data, however, would seem to support the findings reported by Sharp and Reilley (1975) and Young and Ismail (1976) that significant correlations exist between fitness measures and at least some measures on some personality inventories. Similarly, Sonstroem (1976) and Sonstroem and Kampper (1980) have reported significant relationships between Attraction and Estimation scores on the PEAS and measures of adjustment and sports participation in groups of 7th-8th grade boys. Sonstroem and Kampper also found that the Attraction score entered their discriminate function equation first in predicting athletic participation, which is similar to the results of the present report. However, Dishman (1978) found that (a) Attraction scores were not correlated with measures of VO2MAX in male undergraduates, while (b) Attraction scores were correlated with run performance (based on 12-minute run) in a second group of male undergraduates. He hypothesized that the Attraction scale may be more accurate in predicting performance than fitness measures in males; however, we found the Attraction scale to be equally accurate in both tasks, with little difference between males and females.

Interestingly, it should be noted that the subjects in Dishman's study averaged 41.1 (males and females) on the Attraction scale, making them similar to the sample reported earlier by McDonald, Norton, and Hodgdon (1988). It seems likely that differences in reported correlations with Attraction scale scores may simply reflect ceiling effects due to restriction of range. A ceiling effect would not explain all of the discrepancies, however, and it must be assumed that other factors were at work, including population differences between college and military groups. This would most likely include some age-related differences, however small, plus numerous other mediating variables, such as history of sports participation, interest in physical activities, personal motivations, response to social stimuli, and others.

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The ~~primary~~ purpose of the present study was to assess the role of psychological variables (e.g., mood scales, physical estimation and attraction, physical self-concept, andpersonality scales) in predicting physical performance and fitness measures in a sample of military volunteers. Subjects were 102 active duty U. S. Navy personnel, 64 males and 38 females. Subjects performed a number of physical performance and fitness tasks (including 1.5-mile run, carrying task, and incremental treadmill task), and completed a battery of standardized questionnaires. Results were analyzed by multiple regression technique. The primary findings were: (a) questionnaire measures, most notably the Attraction score from the Physical Estimation and Attraction Scale, can be used to predict performance and fitness measures in an active duty Navy sample; (b) while fitness measures are clearly superior to questionnaire measures in predicting physical performance, questionnaire measures, again most notably the Attraction score, can be used to enhance the prediction equation over fitness measures alone; (c) there were only minimal differences between males and females in significance of questionnaire measures to predict performance or fitness.

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